

# What is the relationship between the intake of vegetable protein and blood pressure among adults without hypertension?

## Conclusion

Moderate evidence from both cohort and cross-sectional studies show that intake of vegetable protein is generally linked to lower blood pressure.

## Grade: Moderate

Overall strength of the available supporting evidence: Strong; Moderate; Limited; Expert Opinion Only; Grade not assignable For additional information regarding how to interpret grades [click here](#).

## Evidence Summary Overview

This review included six studies (Alonso, 2006; Elliott, 2006; Stamler, 2002; Steffen, 2005; Umesawa, 2009; Wang, 2008) examining the relationship between vegetable protein and blood pressure (BP) and hypertension (HTN) among adults without HTN published since 2000. Four of the studies were prospective cohort studies (three from the US and one from Spain) and two studies reported cross-sectional analyses (one from Japan and one with 17 populations from the US, UK, Japan and the People's Republic of China).

- *Hypertension*: Three prospective cohort studies, with follow-up from 18 months to 15 years, examined the relationship between the intake of vegetable protein and HTN. Steffen and colleagues (2005) reported an inverse association between consumption of plant foods and elevated BP among participants from the Coronary Artery Risk Development in Young Adults (CARDIA) Study. Alonso and colleagues (2006) found that participants from the Seguimiento Universidad de Navarra (SUN) Follow-up Study who consumed more vegetable protein had a lower risk of incident HTN. In the PREMIER Trial, increased intake of plant protein was significantly associated with a lower risk of HTN at six months, but not 18 months (Wang, 2008).
- *Blood Pressure*: Over nine years of follow-up of men in the Chicago Western Electric Study, inverse relationships were observed between baseline vegetable protein intake and average annual change in systolic BP (SBP) and diastolic BP (DBP) (Stamler, 2002). Inverse relationships between plant protein and SBP and DBP were also observed at the six-month follow-up of the PREMIER Trial (Wang, 2008). Cross-sectional analyses from the INTERMAP Study (Elliott, 2006) and Circulatory Risk in Communities Study (Umesawa, 2009) confirm these findings.

## Evidence Summary Paragraphs

**Alonso et al, 2006** (positive quality) prospectively assessed the role of different nutritional factors, especially protein and fiber from different sources, on the risk of incident HTN in 5,880 adults (61% female; age >20 years) from the Seguimiento Universidad de Navarra (SUN) Follow-up Study in Spain. New cases of medically diagnosed HTN were identified through responses to a mailed questionnaire after at least two years from recruitment. Dietary intake over the previous year was

assessed at baseline with a 136-item semi-quantitative FFQ validated in a Spanish population. Over a median follow-up of 28 months, 180 new cases of HTN were ascertained. After adjustment for potential confounders and several dietary factors, participants in the highest quintile of vegetable protein intake had a lower risk of incident HTN compared with those in the lowest quintile (HR=0.5, 95% CI: 0.2, 0.9; P for trend=0.06). The authors concluded that in this Mediterranean cohort, dietary intake of vegetable protein was associated with a lower risk of HTN when other nutrients were also taken into consideration.

**Stamler et al, 2002** (positive quality) examined the relationships of nutrients, alcohol intake, and change in weight to change in BP over eight years in 1,714 men (age 40 to 55 years) from the Chicago Western Electric Study in the US. Annual follow-up data through examination year nine were used to determine change in BP. At first and second annual examinations, two in-depth interviews were performed to assess usual intake of foods and beverages during the preceding 28 days. Averages of nutrients from the two interviews were used. There was an inverse relationship between baseline vegetable protein intake and average annual DBP change (-0.1353 mmHg; Z-score=-2.80). Similarly, there was an independent inverse relationship of vegetable protein and annual SBP change (-0.2445; Z-score=-2.91). The authors noted that they did not measure intake of salt, potassium, magnesium or fiber, and it is possible that vegetable protein is a marker for intake of these nutrients and is not related independently to BP change.

**Wang et al, 2008** (positive quality) examined the association of dietary protein intake with BP, and particularly, the independent relationship of animal and plant protein with BP over 18 months of follow-up. Participants were 810 adults (62% female; age 25 to 79 years) from the PREMIER Trial (US). Blood pressure measurements were obtained by study personnel at baseline, six and 18 months. Two 24-hour recalls, one on a weekday and the other on a weekend day, were obtained at baseline, six and 18 months. Dietary plant protein was inversely associated with both SBP and DBP in cross-sectional analyses at the six-month follow-up (P=0.0045 and 0.0096, respectively). In longitudinal analyses, a high intake of plant protein at six months was marginally associated with a reduction of both SBP and DBP from baseline to six months only (P=0.0797 and 0.0866, respectively), independent of change in body weight and waist circumference. Furthermore, increased intake of plant protein was significantly associated with a lower risk of HTN at six but not at 18 months. The odds ratio (OR) for the presence of HTN in relation to dietary nutrient and food intake at six months of follow-up was 0.75 (95% CI: 0.60, 0.95; P=0.015). However, when dietary fiber intake was included in the model, the association of plant protein with risk of HTN became insignificant (P=0.079). The authors concluded that plant protein had a beneficial effect on BP and was associated with a lower risk of HTN at six months and suggests that an increased intake of plant protein may be useful as a means to prevent and treat HTN.


**Steffen et al, 2005** (positive quality) evaluated associations of dietary intake, including meat intake, with the 15-year incidence of elevated BP among 4,304 adults (883 black men, 1,249 black women, 989 white men and 1,183 white women; age 18 to 30 years) from the Coronary Artery Risk Development in Young Adults (CARDIA) Study in the US. Blood pressure was assessed at six clinic exams at years zero, two, five, seven 10 and 15. Dietary intake was assessed with an interviewer-administered diet history at years zero and seven. The analyses were conducted by using the average of year zero and year seven dietary data. "Plant food" (fruit, vegetables, whole and refined grains, nuts, and legumes) intake was considered in analyses. Over 15 years, 23.2% of study participants experienced incident EBP, of whom 13.7% had HTN and 9.4% had high-normal BP. Consumption of plant foods was inversely associated with EBP after 15 years of follow-up. The hazard ratio for 15-year EBP incidence between extreme quintiles was 0.77 (95% CI: 0.55, 1.07; P for trend=0.14) in the fully adjusted model. The authors concluded that consumption of plant foods was inversely associated with 15-year cumulative incidence of EBP in black and white men and






women.

**Elliott et al, 2006** (positive quality) examined the association of vegetable, animal and total protein intake with BP in a cross-sectional epidemiological study involving 17 populations in four countries (US, United Kingdom, Japan and the People's Republic of China) from the INTERMAP Study. Participants were 4,680 adults (50% female; age 40 to 59 years). Systolic and diastolic BP were measured eight times during four visits. Dietary intake was based on 24-hour dietary recalls recorded four times. There was a significant inverse relationship between vegetable protein intake and BP. After adjusting for confounders, BP differences associated with higher vegetable protein intake of 2.8% kilocalories were -2.14 mmHg SBP and -1.35 mmHg DBP ( $P < 0.001$  for both); after further adjustment for height and weight, these differences were -1.11 mmHg systolic ( $P < 0.01$ ) and -0.71 mmHg diastolic ( $P < 0.05$ ). The authors concluded that vegetable protein intake was inversely related to BP.

**Umesawa et al, 2009** (positive quality) examined the association between protein intake, including plant protein and BP in a cross-sectional study of 7,585 Japanese adults (54% female) from the Circulatory Risk in Communities Study (CIRCS). Systolic and diastolic BP was obtained using the first measurement made by trained health professionals. Dietary intake of plant protein was estimated by a single 24-hour dietary recall. Among men and women without anti-hypertensive medication, a 13.1 g per day increment in plant protein intake was associated with a decrease in SBP of 0.48 mmHg and in DBP of 0.61 mmHg ( $P = 0.047$  and  $P < 0.001$ , respectively) after adjustment for cardiovascular disease risk factors.

 [View table in new window](#)

Author, Year, Study Design, Class, Rating	Study Name	Location	Vegetable Protein Association (Pos, Neg, None)
Alonso A, Beunza JJ et al, 2006  Study Design: Prospective cohort study  Class: B  Rating: 	Seguimiento Universidad de Navarra (SUN) Follow-up Study.	Spain.	(-) HTN.
Elliott P, Stamler J et al, 2006  Study Design: Cross-sectional study	INTERMAP Study.	US, UK, Japan, and the People's Republic of China.	(-) SBP, (-) DBP.

Class: D			
Rating: 			
<p>Stamler J, Liu K et al, 2002</p> <p>Study Design: Prospective cohort study</p> <p>Class: B</p> <p>Rating: </p>	Stamler Western Electric Study.	US.	(-) SBP, (-) DBP.
<p>Steffen LM et al 2005</p> <p>Study Design: Prospective Cohort Study</p> <p>Class: B</p> <p>Rating: </p>	Coronary Artery Risk Development in Young Adults (CARDIA) Study.	US.	“Plant food”: (-) Elevated BP.
<p>Umesawa M, Sata S et al, 2009</p> <p>Study Design: Cross-sectional study</p> <p>Class: D</p> <p>Rating: </p>	Circulatory Risk in Communities Study (CIRCS).	Japan.	(-) SBP, (-) DBP among those without antihypertensive medication.
<p>Wang YF, Yancy WS et al, 2008</p> <p>Study Design: Prospective cohort</p> <p>Class: B</p> <p>Rating: </p>	PREMIER Trial.	US.	(-) SBP, (-) DBP at six months, (-) HTN at six months, but not 18 months.


## Research Design and Implementation Rating Summary


For a summary of the Research Design and Implementation Rating results, [click here](#).


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### Worksheets


 [Alonso A, Beunza JJ, Bes-Rastrollo M, Pajares RM, Martínez-González MA. Vegetable protein and fiber from cereal are inversely associated with the risk of hypertension in a Spanish cohort. \*Arch Med Res\*. 2006 Aug; 37 \(6\): 778-786.](#)

 [Elliott P, Stamler J, Dyer AR, Appel L, Dennis B, Kesteloot H, Ueshima H, Okayama A, Chan Q, Garside DB, Zhou B for the Intermap Research Group. Association between protein intake and blood pressure. \*Archives of Internal Medicine\*, 2006; 166: 79-87.](#)

 [Stamler J, Liu K, Ruth KJ, Pryer J, Greenland P. Eight-year blood pressure change in middle-aged men: Relationship to multiple nutrients. \*Hypertension\*. 2002 May; 39 \(5\): 1,000-1,006.](#)

 [Steffen LM, Kroenke CH, Yu X, Pereira MA, Slattery ML, Van Horn L, Gross MD, Jacobs DR Jr. Associations of plant food, dairy product, and meat intakes with 15-y incidence of elevated blood pressure in young black and white adults: the Coronary Artery Risk Development in Young Adults \(CARDIA\) Study. \*Am J Clin Nutr\*. 2005 Dec;82\(6\):1169-77.](#)

 [Umesawa M, Sato S, Imano H, Kitamura A, Shimamoto T, Yamagishi K, Tanigawa T, Iso H. Relations between protein intake and blood pressure in Japanese men and women: The Circulatory Risk in Communities Study \(CIRCS\). \*Am J Clin Nutr\*. 2009 Aug; 90 \(2\): 377-384.](#)

 [Wang YF, Yancy WS Jr, Yu D, Champagne C, Appel LJ, Lin PH. The relationship between dietary protein intake and blood pressure: Results from the PREMIER study. \*J Hum Hypertens\*. 2008 Nov; 22 \(11\): 745-754.](#)